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**AIJ Guidelines for Maintenance and  
Management of Structures in Nuclear Facilities**  
**Revised in 2015**

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Revised in 2015

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Purpose of the revision of the AIJ Guidelines for Maintenance and Management of Structures in  
Nuclear Facilities

— Dec. 2015 Revised Edition —

Safe long-term operation of nuclear facilities depends heavily on proper design, construction, and maintenance.

An increasing number of nuclear power plants have now been in service for more than 30 years. Accordingly, the importance of the maintenance of nuclear facilities is increasing, in addition to the traditionally recognized importance of their design and construction. Until now, however, the maintenance of structures in nuclear facilities has been performed by individual power companies and there have been no unified guidelines.

Against this backdrop, the previous edition of the present Guidelines was established in 2008 as a set of guiding principles that set standards for maintenance work to be performed to maintain the functions required of structures in nuclear power plants over a long period. Since then, the present Guidelines have been useful in a wide range of maintenance activities from daily inspection to structure soundness evaluation with a focus on aging (plant life management [PLM]).

Meanwhile, concrete containment vessels were outside the scope of the 2008 Edition. Recently, however, awareness has grown of the need to develop guidelines for plant life management. Moreover, in the wake of the Fukushima-Daiichi nuclear power plant accident in March 2011, new regulatory standards were introduced to require that the safety of nuclear power plants be more rationally explained to the nation. Consequently, it became necessary to enhance the Guidelines.

Additionally, an issue shared among countries operating nuclear power plants has been how to ensure safe long-term operation of nuclear facilities. The number of nuclear power plants now in service for more than 30 years has been increasing around the world year by year. The results of surveys by the International Atomic Energy Agency (IAEA) and the United States Nuclear Regulatory Commission (US-NRC) and the latest findings in concrete engineering have revealed the existence of initially unexpected degradation phenomena and degradation factors.

Therefore, this revised edition includes appendices on the maintenance methodology for prestressed concrete containment vessels, which pose an urgent problem requiring more attention than any other type of concrete containment vessel. In awareness of the growing sophistication of maintenance methods, the Appendices include a compressive strength test method by midsize core sampling less invasive to structures and a method of verifying the conventionally hard-to-access characteristics of concrete of steel plate reinforced concrete structures. Moreover, Chapter 2 “Basis for maintenance” and Chapter 6 “Inspection” of the present Guidelines have been enhanced in content to clarify the basic position of the present Guidelines that it is important to reduce the use of local destructive testing invasive to structures, and use instead visual and non-destructive testing as the main forms of inspection for maintenance. Furthermore, based on the results of the latest surveys conducted in Japan and abroad, the Guidelines reflect the latest technical knowledge, including initially unexpected

degradation phenomena and degradation factors.

In FY 2009, the Architectural Institute of Japan (AIJ) reorganized its committees on structures for nuclear facilities. AIJ's "Subcommittee on Structures for Nuclear Facilities," which had been immediately under AIJ's Research Committee on Structures for the several preceding years, became AIJ's "Managing Committee on Structures for Nuclear Facilities," under which several subcommittees were set up. An approximately three-year-long discussion has led to the publication of the 2015 Revised Edition of the AIJ Guidelines for Maintenance and Management of Structures in Nuclear Facilities. Draft versions were prepared by the Working Group on Aging Assessment and the Working Group on Preparation for the Revision of the Maintenance Guidelines and were collated as necessary by AIJ's Subcommittee on Maintenance of Structures for Nuclear Facilities and reported to and by AIJ's Managing Committee on Structures for Nuclear Facilities.

An outline of the contents of proceedings in the Subcommittees and the Managing Committee is disclosed on AIJ's website. The Subcommittees and the Managing Committee accepted attendance of observers other than their members. The resulting final draft was internally reviewed by the Managing Committee. At the same time, views and opinions were sought from the members of AIJ's Research Committee on Building Materials and Construction Procedure. Then, public comments were sought to make amendments prior to review by AIJ's Research Committee on Structures. It can be safely said that the draft version of the revised Guidelines was substantially verified for a considerably high level of fairness, impartiality, and openness through the formulation process. AIJ hopes that the present Guidelines with Commentary will be useful to the reader.

It is expected that new degradation phenomena and degradation factors will emerge as nuclear power plants exceed 40 years of operation and continue to be in operation by extension of their inservice period to 50 and 60 years. Accordingly, as new knowledge becomes available, the present Guidelines with Commentary shall be reviewed as necessary.

December 2015

Architectural Institute of Japan

## Preface

According to the FY 2007 edition of the Annual Report on Operation Management at Nuclear Facilities in Japan published by the Japan Nuclear Energy Safety Organization (JNES), the number of nuclear facilities in operation in Japan as of March 2007 (year-end of FY 2006) is broken down as follows: 55 nuclear power generation reactors for electricity business (total installed capacity of approximately 50 GW), 6 nuclear fuel processing facilities, 1 spent-fuel reprocessing facility, and 4 radioactive waste disposal facilities. The merits of properly designing, constructing, and maintaining these nuclear facilities to ensure their safe long-term operation are too obvious to discuss, and at the core of the foregoing are structures in nuclear facilities.

Regarding the design and construction of structures in nuclear facilities, the Architectural Institute of Japan (AIJ) has made its fair share of contributions and prepared relevant guidelines including the Recommendations for Design of Concrete Containment Vessels for Nuclear Power Plants, the Recommendations for Structural Design of Reactor Buildings, the Japanese Architectural Standard Specification JASS 5N Reinforced Concrete Work at Nuclear Power Plants, and the AIJ Standard for Structural Calculation of Reinforced Concrete Structures for Nuclear Power Facilities. In addition, AIJ members have provided assistance for the development of related JEA Guidelines and JSME Standards.

Currently, there are a total of 13 nuclear power generation reactors that have now been in service for more than 30 years, including JAPC's Tsuruga Nuclear Power Plant Reactor 1 (which started operating in March 1970), KEPCO's Mihama Nuclear Power Plant Reactor 1 (November 1970), and TEPCO's Fukushima Daiichi Nuclear Power Plant Reactor 1 (March 1971). Accordingly, the importance of maintenance of nuclear facilities is increasing alongside the traditionally recognized importance of their design and construction. A simplistic attempt to maintain the characteristics expected at the time of design may result in irrational maintenance. Hence, it is important to ensure that the required functions will be maintained through a comprehensive evaluation of data obtained from existing structures, newly available knowledge, and other information in addition to the characteristics assumed at the time of design. It is also important that information be exchanged and shared among operators. So far, in the absence of standardized criteria and guidelines, structures in nuclear facilities have been maintained independently by each operator. Under such circumstances, needs and expectations were growing for AIJ to establish a set of maintenance guidelines for nuclear facilities. In FY 2005, AIJ's Subcommittee on Structures for Nuclear Facilities was set up under AIJ's Research Committee on Structures with purposes including the establishment of a set of maintenance guidelines.

An approximately two-year-long discussion led to the establishment of the draft of the AIJ Guidelines for Maintenance and Management of Structures in Nuclear Facilities. The Subcommittee accepted the attendance of observers other than its members and disclosed the content of the proceedings in the form of a digest version of the minutes. Views and opinions were sought from AIJ's Research Committee on Building Materials and Construction Procedure to make amendments to the draft. The amended draft was reviewed by AIJ's Research Committee on Structures. Finally, the

Publication Committee approved and authorized the publication of the present Guidelines with Commentary. It can be safely said that this publication was substantially verified for a considerably high level of fairness, impartiality, and openness through the formulation process. AIJ hopes that the present Guidelines with Commentary will be useful to the reader.

July 2008

Architectural Institute of Japan

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